

# How to Support Forest Management in a World of Change: Results of Some Regional Studies

C. Fürst · C. Lorz · H. Vacik · N. Potocic ·  
F. Makeschin

Received: 19 February 2009 / Accepted: 24 July 2009 / Published online: 29 August 2009  
© Springer Science+Business Media, LLC 2009

**Abstract** This article presents results of several studies in Middle, Eastern and Southeastern Europe on needs and application areas, desirable attributes and marketing potentials of forest management support tools. By comparing present and future application areas, a trend from sectoral planning towards landscape planning and integration of multiple stakeholder needs is emerging. In terms of conflicts, where management support tools might provide benefit, no clear tendencies were found, neither on local nor on regional level. In contrast, on national and European levels, support of the implementation of laws, directives, and regulations was found to be of highest importance. Following the user-requirements analysis, electronic tools supporting communication are preferred against paper-based instruments. The users identified most important attributes of optimized management support tools: (i) a broad accessibility for all users at any time should be guaranteed, (ii) the possibility to integrate iteratively experiences from case studies and from regional experts into the knowledge base (learning system) should be given, and (iii) a self-explanatory user interface is demanded, which is also suitable for users rather inexperienced with electronic tools. However, a market potential

analysis revealed that the willingness to pay for management tools is very limited, although the participants specified realistic ranges of maximal amounts of money, which would be invested if the products were suitable and payment inevitable. To bridge the discrepancy between unwillingness to pay and the need to use management support tools, optimized financing or cooperation models between practice and science must be found.

**Keywords** Forest management · Management support tools · User requirements · Delphi study · Information and decision process · Market potentials

## Introduction

Forestry has undergone a considerable change of its socio-cultural acceptance and public perception since the 1950s. Before, timber production, contribution to national economy, and the provision of employment in rural areas were major requests of society. After World War II the complexity of societal demands increased. Foresters faced more and more the need to integrate multiple and often contradicting demands on forest management planning (Fürst and others 2007; Johann 2007; Vos and Meekes 1999). An agreed aim for future development of Europe's forests was to ensure their sustainable use and management. However, a broad variety of regional concepts and interpretations of sustainable forestry can be found for Europe (Kissling-Näf and Bisang 2001; Andersson and others 2000; Farell and others 2000). Recently, the target to obtain 20% of Europe's energy needs from renewable sources by 2020 (EU renewable energy policy) sharpened the discussion on the compatibility of an increased timber use from forests and the sustainable fulfillment of other functions of forests on

C. Fürst (✉) · C. Lorz · F. Makeschin  
Institute for Soil Science and Site Ecology, Dresden University of Technology, Pienner Road 19, 01737 Tharandt, Germany  
e-mail: fuerst@forst.tu-dresden.de

H. Vacik  
Institute of Silviculture, University of Natural Resources and Applied Life Sciences Vienna, Peter Jordan-Straße 82, 1190 Wien, Austria

N. Potocic  
Croatian Forest Research Institute Jastrebarsko, Cvjetno naselje 41, p.p. 40, 10 450 Jastrebarsko, Croatia

landscape level, such as provision of drinking water, conservation of biological diversity, or provision of recreation areas (Stupak and others 2007).

The majority of forests in Europe have multidimensional use, i.e., forests fulfill at the same time a number of ecological, economic, and social functions (Farell and others 2000). A functional prioritization of forest is rather the exception than the rule, e.g. protective forests (water, erosion, and recreation), nature conservation areas or agroforestry systems, where substantially different management strategies must be applied (Führer 2000). The broad variety of overlapping demands affects management strategies as well as operational plans and leads frequently to considerable target conflicts. Therefore, it should be discussed (i) how to deal with the resulting target setting and decision problems and (ii) how to improve the decision-making processes and decision support capabilities in the context of increasing complexity (Rauscher and others 2005).

The concept of multifunctionality forces forest managers to consider a broad range of ecosystem attributes at various spatial and temporal scales (Baskent and others 2008). In consequence, multifunctional use of forests became subject to critical discussions (e.g., Parviaainen and Frank 2003; Buttoud 2002; Führer 2000). In many European countries even the importance of forestry as a key supplier of renewable resources is questioned. Instead, the provision of non-marketable goods and services, such as recreation, biodiversity, C-sequestration, climate protection, and nature conservation became more and more important (Spieker 2002). However, the provision of industrial wood is worldwide still of highest importance and has led to overexploitation and destruction of natural forests (e.g., Castella and others 2006; Shimamoto and others 2004; O'Didia 1997). In addition, political decisions influenced by regional and local pressure groups prevail often over general societal needs, which have no or only a minor lobby (e.g., Montiel and Galiana 2005; Weiss 2004). Impacts and consequences of political decisions for forest and environmental management have to be analyzed in a way that biased overemphasis of economic or ecological aspects is avoided and unwanted impacts on environment and society are minimized (Wohlgemuth and others 2002).

As a further complication, changing environmental conditions must be considered in forest management (Martinez de Anguita and others 2008). These might affect the degree of fulfillment of forest functions and might even lead to the unattainability of socially desirable management tasks. An example is the output of biomass for energy production, which depends strongly on regional climate. Changing annual precipitation and temperatures might impact the amount of produced timber, the production time (rotation period) and the production risk.

These facts emphasize the need for tools, which support forest management on landscape level and in context with other land-use forms to balance the effects of possible future scenarios. In this regard, modern forest management might benefit from a scientific view on forest ecosystems and from tools for modeling, decision support, and Information and Communication Technology (ICT). Due to the general complexity of management questions, a system analysis including feedback and dependencies between the different system elements seems to be the most reasonable approach (Wolfslehner and Vacik 2008). The rationale is to combine the strengths of available tools, methods, and models for supporting forest management at strategic and operational planning level. However, the use of support tools in practice requests the acceptance by the user. Systems, which deal with complex questions address often only scientists and run the risk to become too complicated for the end-user in practice (Uran and Janssen 2003). Therefore, consideration of user requirements must be a crucial part of the technical development from the beginning on.

This article presents results of a number of studies dealing with the following questions, (i) major needs in forestry considering management support tools and their most important application areas, (ii) most desirable properties for an optimized management support tool, and (iii) marketing potentials for such tools. The findings were summarized to obtain a broader view on application areas, optimal concepts, and market potentials of management support tools. Every study was carried out with different regional focus. The study “REFORMAN” was funded in the frame of the Era-Net activity SEE with focus on Middle and Southeastern Europe. A parallel analysis with focus on Eastern Europe was carried out in the study “REG-TRANSEKT” within the program “Marketing of research results in Middle, Eastern and Southeastern Europe” of the German Federal Ministry of Education and Research. The regional studies “IT-REG-EU” (INTERREG III a) and ENFORCHANGE (Sustainable Forestry, German Federal Ministry of Education and Research) complemented the analysis with focus on the Euro Region Neisse (Czech Republic, Germany, Poland).

Owing to the different regional focus and extend of the studies, the number and the origin of persons involved are not fully identical. Those who replied on question (i) formed a subset of those who contributed to the market potential analysis (iii). For question (ii) an in-depth analysis was carried out in Germany, Czech Republic, and Poland and the participants formed a subset of those who contributed to question (i) and (iii). The selection of the participants intended to involve users from different hierarchical levels in forest administration or forest enterprises and from forest-related economic and administrative institutions. In

addition, it was essential to involve persons, who were willing to contribute to the studies over a longer time period and who could be contacted electronically or by phone/fax by the regional partners. This procedure might have excluded the point of view of those, who were not part of this group. In consequence, the choice of participants was not random and therefore results might be biased.

### Case Study Regions and Frame Conditions

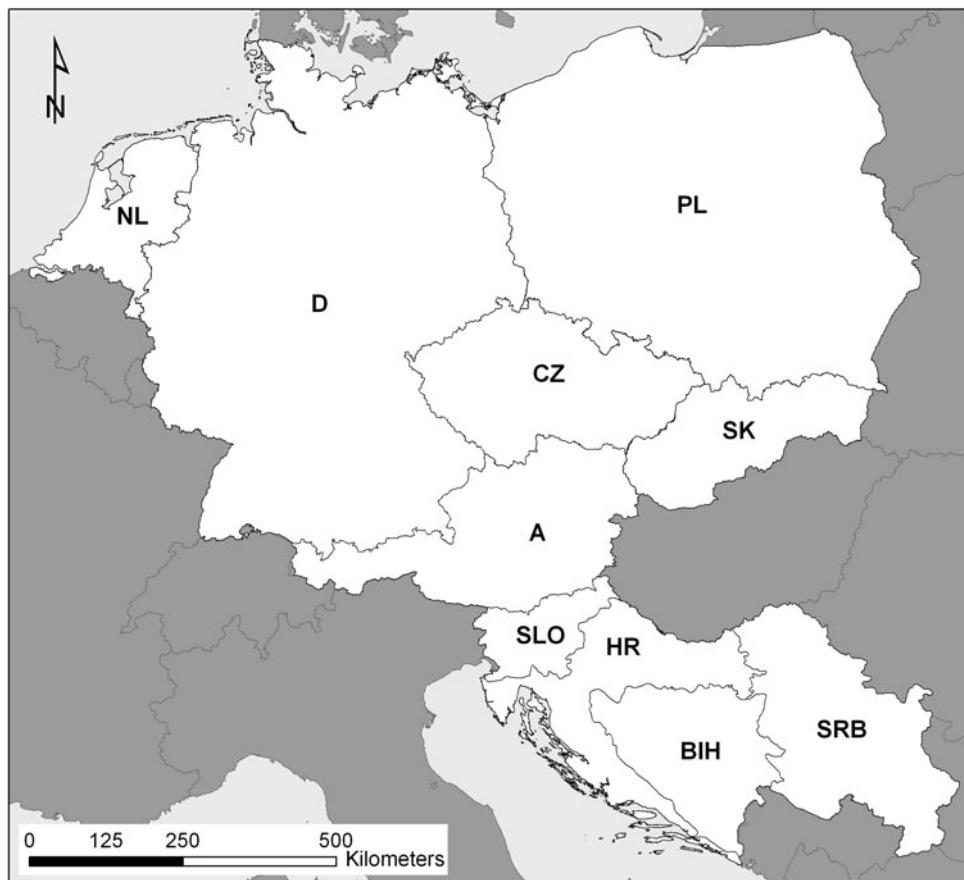
Within the above described concerted studies major fields of interest, areas of application, and user needs regarding management support tools in forestry were analyzed. The studies included experts from Austria, Bosnia and Herzegovina, Croatia, Czech Republic, Germany, Serbia, Slovakia, and Slovenia; a few participants were from Poland and The Netherlands (Fig. 1).

A general aim of these studies was to see if differences exist depending on the political and socio-economic background in the countries and the current management system in forestry. An analysis of the impact of differing political and socio-economic frame conditions in the involved countries on forest policies was done on the basis of national reports and additional surveys (Vuletic and others

submitted). The legislative frame in each of the participating countries consists of various legal acts. However, these acts define (even in the new member and candidate countries of the EC) very similar ideas of forest management as well as nature protection issues related to national forest policies. The analysis of instruments and tools used in forest legislation shows a broad agreement of forest and environmental policies in the different countries. Regarding the impact of different socio-economic frame conditions in the participating countries, no trend could be found that economic, ecological, or social services are of different importance in the emerging economies in Eastern and Southeastern Europe compared to “old” economies such as Austria or Germany.

As a Europe wide trend a separation of tasks of physically managing forests from the governmental tasks of policy, legislation, and supervision can be observed since more than 25 years (e.g., Ljungman 1994; Pettenella 1994). A detailed description of the resulting different institutional structures and approaches, variation in legal rights and duties between private and public institutions, and also differences in the share of duties between national and local levels exceeds by far the scope of the presented analysis. However, based on the above mentioned national reports, different development states of such a separation

**Fig. 1** Countries that were involved in the study series in Europe



could be identified in the participating countries. They result in different the legal forms of state forestry and how and where the supervision and consultancy on non-governmental forests is managed.

Principally, two clusters can be identified, (i) countries with a more or less “traditional” form of the forest administration where management of state forests and support of non-governmental forest owners are not institutionally separated. This applies, e.g., for Czech Republic, Poland, Slovenia, and some federal states of Germany. (ii) In most other countries state forest enterprises have different legal forms, from joint stock companies to public corporations. These institutions are almost exclusively responsible for the management of governmental forests, while supervision and consulting of non-governmental forests is carried out by separate (governmental and non-governmental) institutions. Within the scope of the presented studies, the question was raised if differences between these two clusters can be observed regarding the use of management support tools and the used types of management support tools.

## Analysis of User Demands

### Analysis of Major Application Areas Where Management Support Is Needed

Possible areas of interest for supporting forest management were analyzed in a discursive process, using mind-mapping techniques (Buzan 1995) in two regional workshops. These were held in Croatia with a focus on participants from Central and South-Eastern Europe and in Slovakia with focus on participants from Eastern Europe. A total number of 27 participants contributed to this analysis. The majority came from national forest administrations or state forest enterprises and some from agencies and NGO's dealing with forestry and environmental management. The participants were asked to express their ideas on present and future application areas for management support. In a second step, the participants had to decide on which scale levels (local/regional or national/EU level) they would assign the identified future application areas. In a subsequent discussion the findings were clustered to more generic terms for the application areas to identify trends for present and future and for local/regional and national/EU wide level.

### User Requirements Analysis

The user requirements analysis asked for an optimal solution of a decision support system. This analysis was designed as Delphi study (Cooke 1991; Dalkey and Helmer

1963; Scholles 2001; Turoff and Linstone 1975). In contrast to opinion polls with random choice of the participants and missing opinion feedback, the Delphi approach is thought to obtain a consensus among individuals, which have special knowledge on the issue of interest (EVALSED 2003; Schmidt-Thomé 2005). A further advantage of the Delphi method is the anonymity of its participants, which allows them to interact, rethink, and compare their thoughts in a “non-threatening forum” and thus without being influenced by each other's opinion (Miller 1993). Van Paassen and others (2007) used the approach to develop numeric models facilitating the capability of learning about sustainable land-use in rice-cultivating regions. White and others (2004) developed an empirically based area-type model using the Delphi method. Within the presented study, the Delphi method was applied for an in-depth analysis with a number of selected experts in Czech Republic, Germany and Poland. The three countries share the management planning responsibilities within the Euro region Neisse. This region was chosen as a representative example, since the political situation poses specific demands on regional forest managers and management planners. They are not only forced to consider the legal background and various needs of actors in the national planning process, but they also have to achieve agreement with their counterparts in the respective neighboring countries. Examples for this challenging process are delineation of habitat protection area (Natura 2000, habitat directive 92/43/EWG) or management of forests to mitigate flooding from the Neisse River. In consequence, the interest to be supported by sophisticated management tools is particularly high (Fürst and others 2008).

32 experts from forestry (47%), nature protection (33%), water management (10%) and regional planning including tourism (10%) in Czech Republic, Germany and Poland were involved in this regional study. In the first round of the Delphi study three questions were asked.

- I. What kind of information sources are you usually using to prepare interdisciplinary planning decisions?
- II. Which tools are you using to visualize the planning process and to support your decision?
- III. How do you think an optimal support system should look like that helps to prepare the necessary information and support you as a decision maker?

For each question a set of pre-selected alternatives was offered including the possibility to give additional comments. The participants were asked to evaluate the alternatives and their own comments on a scale from 1 (=always most desirable) to 6 (=never/most undesirable). In the second round of the Delphi study only question (iii) was repeated including pre-selected answering alternatives and the possibility to give additional comments. For the

second round an evaluation of the results from the first round was prepared and communicated to the participants of the study in the context of a workshop. For those who could not participate in the workshop a document was prepared to enable this group to participate in the second stage of the Delphi study.

### Market Potential Analysis

With regard to the market potential analysis the Delphi study outcomes helped to identify some exemplary management and decision support tools. Some selected tools were integrated as test versions or linked with the webpage of the online-questionnaire of the market potential analysis. This comprised GIS-based solutions as well as decision and management support tools on different scale levels for environment, forestry, and agriculture. All examples were offered for testing at the project webpage. The intention was to give the participants examples of different level of complexity to support them in better appraising their willingness to pay for such exemplary solutions.

The market potential analysis was carried out (i) to complete information on major application areas and user requirements and (ii) to get information on the willingness to pay for management support tools. The analysis was designed as one-time survey (Borg and Gall 1989) as online questionnaire. Again, a set of standardized alternatives for answers was offered, including the option of additional free comments. A number of 37 end-users from Central, Eastern and Southeastern Europe participated in this study. The participants were asked 10 questions split into four blocks. The questions in block I coped with the professional background of the participants. Block II was dedicated to conflict fields on local/regional and national/EU level, where management support systems could be helpful. In Block III, the phase in the decision process, where support would be preferred and the preferred technology were asked. The last question block IV analyzed the willingness to pay for different possible types of management support tools.

## Results

### Analysis of Major Application Areas Where Management Support Is Needed

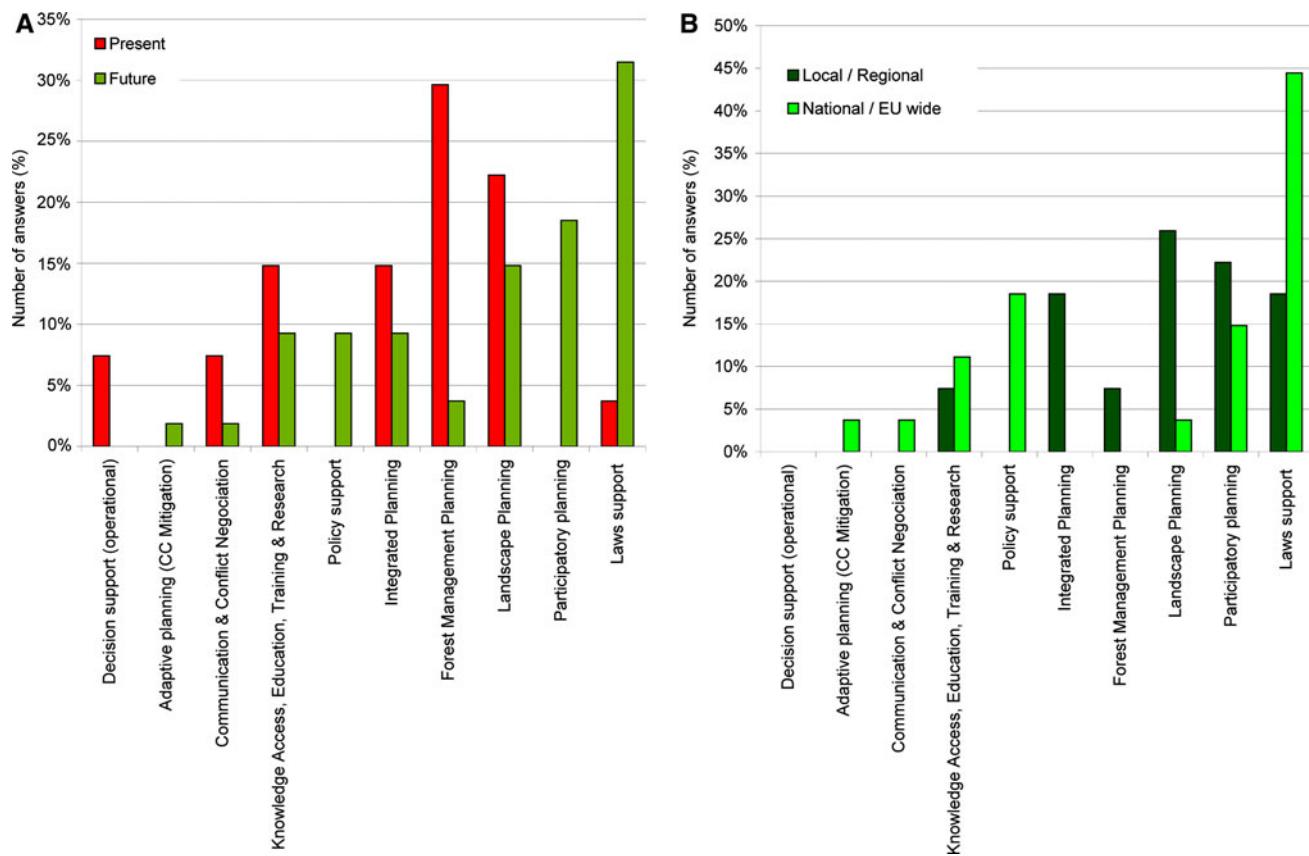
Results of the mind mapping based identification of application areas were transformed for better understanding into two diagrams (Fig. 2a, b). Application areas were ranked at the abscissa in ascending order according to the number of answers with reference to future application areas. This was done to make better comparable Fig. 2a

and b. The latter figure specifies at which spatial scale the future application areas are considered to play a role.

At present the application area “forest management planning” is considered as most important application area and is defined in a very narrow sense according to terms assigned by the participants (Fig. 2a). Still, traditional instruments such as paper-based forest management plans or written documents (operational instructions on Management Planning Unit level) are used and considered as sufficient in the current situation. The application area “landscape planning”, i.e., integration of forest management planning into land-use management planning, was the second most important area. All other application areas were ranked much lower. In contrast, the participants see the support of new laws and directives (“law support”) as most important application area for a possible management support tool. Terms assigned to this generic term refer mainly to the support of the realization of EU regulations and reflect thus the expected increasing complexity in legal aspects, which must be considered in management decisions.

By comparing present and future application areas a trend is emerging from preferred support in sectoral planning (expressed by the high importance of forest management planning) towards “landscape planning” and integration of multiple stakeholder needs in planning (“participatory planning”). The application area “forest management planning” is believed to loose substantially in importance in the future. Parallel to this finding, “operational decision support” seems to be more relevant at present. The participants saw also a need to address in the future ongoing changes to higher extent, a topic which is not seen to be as important at present. This was expressed by the identification of a future application area “adaptive planning” with specific reference to Climate Change. In addition “policy support” was exclusively identified as a future application area.

By looking at future application areas (Fig. 2b), the participants assigned the application areas “adaptive planning” and “policy support” and also “communication and conflict negotiation” especially on national level/EU level. By comparing results (Fig. 2a, b) it becomes obvious that application areas on national/EU wide level are believed to gain in importance. Those application areas, which are thought to play only a minor role in the future (Fig. 2a) such as “forest management planning”, “integrated planning”, or “landscape planning” are mostly found on local/regional level (Fig. 2b). An exception is the application area “participatory planning”, where higher importance is seen on local/regional level due to an expected increase of the involvement of local and regional stakeholders in the definition of forest management targets on operational level. The participants agreed that the extreme importance of the



**Fig. 2** **a** Application areas for management support at present and future; **b** future application areas for management support on local/regional and national/EU-wide level

support of the implementation of laws and new regulations/directives on national and EU level refers mainly to nature protection (e.g. Natura 2000, Biodiversity Convention, etc.) with a high uncertainty of their impact on forest management planning.

#### User Requirements Analysis

The Delphi study revealed that multiple information sources are usually used to make decisions without any particular preference (question I). This comprises information from publications, consultation of expert knowledge, web-based information, and personal and institutional experiences. However, in planning and decision processes (question II) computer-based tools and tools supporting the communication with other actors are clearly preferred against paper-based tools, e.g. handbooks or written guidelines. Geographical Information Systems (GIS) and standard Office applications are the most common instruments followed by interactive databases and institution-specific planning software. The analysis showed that professional system solutions for decision support are used very rarely in the participating countries. More frequently,

a subjectively composed, “home-made” combination of fragmented solutions (spreadsheets for calculation, mailing for communication, GIS for visualization and spatial analysis) is used, where single components are not or only badly linked. Consequently, the definition of an optimal system (question III) seemed to be very subjective or institution specific in the first Delphi study run. The participants proposed a wide range of desirable solutions and attributes with no preference. In the second run, after learning from the high variability of preferences in the first run, the participants favored online-portals and professional information/expert systems, followed by best practice manuals and electronic decision trees. A consensus on the most important attributes of an optimal management support tool was achieved. An optimal tool according to the participants is characterized by

- broad accessibility for users at any time and any place, e.g., provision of an online service or online support.
- the possibility to integrate iteratively experience from case studies and from regional experts as well as future scientific results into the knowledge base of the tool (i.e., learning system). The need to refer the

support as best as possible to real-world conditions and most recent knowledge was emphasized by the participants.

- (iii) self-explanatory user interface, as precondition for broad acceptance and use. The system must be suitable for users inexperienced with the use of computer-based tools. This is especially the case on the operational level in management planning, which so far was more or less excluded from the use of electronic or even web-based management support tools.

In summary, an optimal solution was defined to be “a common management support basis for different actors involved in planning decisions, which provides generalized conclusions on the effects of forest management measures in the landscape context”.

### Market Potential Analysis

The 37 participants of the market potential analysis came from Germany (34%), Slovakia (26%), Czech Republic (26%), Poland (5.5%), Slovenia (5.5%), and Croatia (3%). Most of the participants worked in education (23%) and administration on regional (23%) and national (18%) level. Some work in nature protection organizations (15%) or other NGO's (3%) and as consultants (9%), at public enterprises (6%) and at research organizations (3%). The working position of the participants was mostly connected to research and development (34%), followed by administrative (26%) and management (25%) positions. A lesser number was working in production (6%) as well as landscape protection (3%), landscape planning (3%) and development planning (3%).

The participants identified a clear dominance of conflicts on a local to regional level between infrastructural planning (road construction, housing) and land-use management, including forest management. All other fields of conflict seemed to be of lower importance (Fig. 3a). On a national and European level a broader variety of fields of conflict were considered as important. The conflict of interests between nature protection, land-use management, and forest management seemed to be of highest importance (Fig. 3b). However, these tendencies were less distinct compared to local to regional level. Thus, they provide less information on conflict fields best supported by using management support tools. Figures 3a and b show the quota of answers, which were given to the ranks at each term. The ranking of alternatives was conducted on a scale from 1 (most important) to 5 (least important/unimportant).

Considering the application of management support tools the participants showed a preference to use them

during planning and preparatory phase (Fig. 4a). However, the preference trends shown in Fig. 4a are fairly inexplicit. Depending on the stakeholder's main activity areas, also the use in the implementation and planning phases gained importance. The preferred technological solutions were freeware download from internet or free online services. Products and services liable to pay costs were hardly ever preferred and written documents even less (Fig. 4a, b). The ranking of the alternatives was again on a scale from 1 (most important) to 5 (least important/unimportant).

A difference in the needs and aims of two country clusters “countries with traditional forest administration” and “countries with separation of forest administration and forest management” could not be found in the presented study. This was also confirmed by direct discussions with the participants.

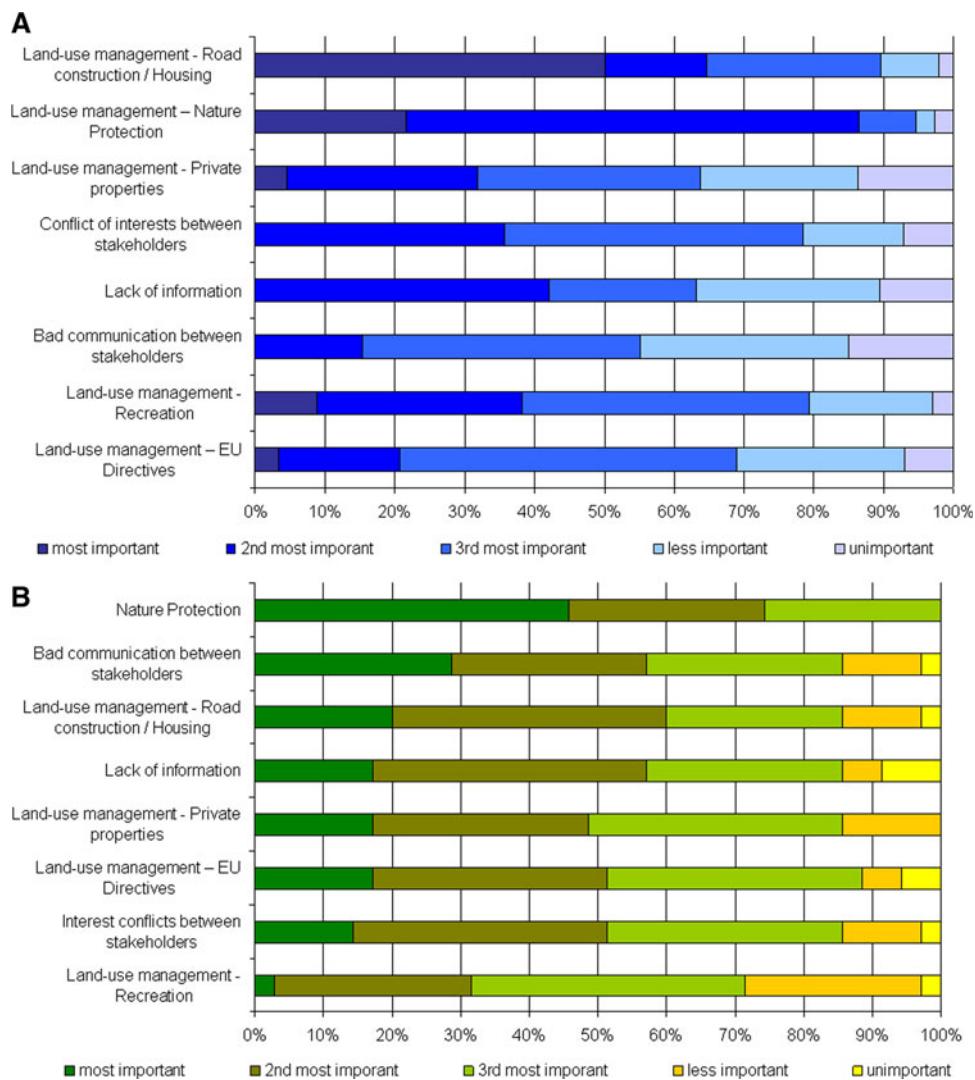
The analysis of the willingness to pay for management support tools revealed that such willingness nearly does not exist. The users had the option to test different tools, which were implemented on the questionnaire webpage and they mostly had a look on them proofed by the clicking rates and session lengths, which were automatically recorded by the system. Consequently, at least basic knowledge on the presented exemplary solutions with different levels of complexity can be assumed. Around 90% of the participants pointed out that they would prefer not to pay for purchasing a management tool or service. If participants are forced to pay for software licenses or services, they would prefer to pay maximally one time to avoid annual or monthly fees. The willingness to pay a lump sum for software was higher than for online services. Participants were even willing to pay up to 1,000 € for a software, but only up to 100 € for an online service. An acceptable sum for a written document, e.g. a handbook amounted to 50 €.

### Discussion

The presented studies were carried out to identify trends of user preferences considering the use and the profile of management support tools. An additional aim was to get an idea on possible future research fields in the different participating countries with a focus on Central, Eastern and South-Eastern Europe. However, the concerted analysis of these studies might have led to biased results, since participants were not the same in all studies, but were selected for reasons explained in the introduction.

Consequently, some of the identified trends might be singular and also influenced by subjective needs and experiences of the participants. The rather contradicting picture of use of information sources and in application of management support tools in different phases of the planning process might result from individual preferences of

**Fig. 3** **a** Conflict fields on local to regional level; **b** conflict fields on national to EU level

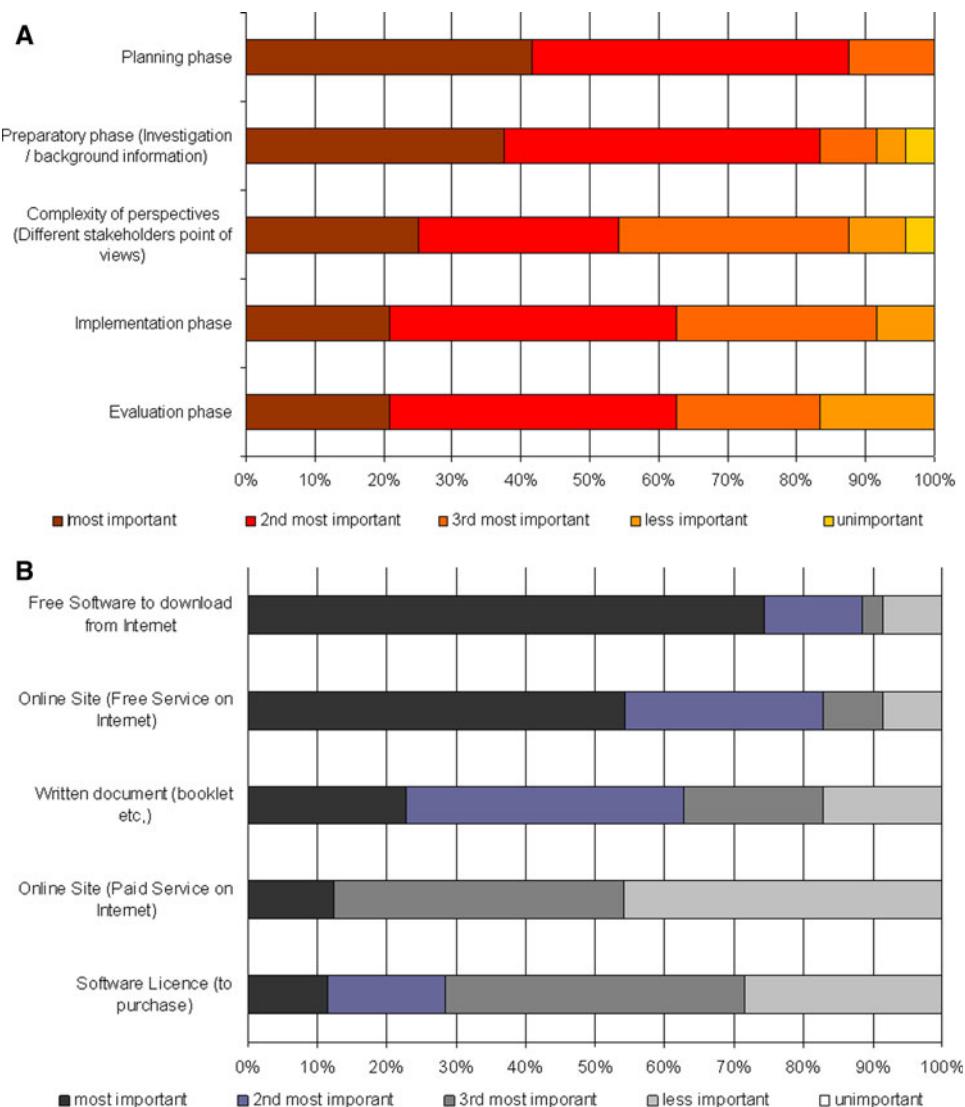


the participants. Other reasons might be heterogeneous working areas and working positions, which result in differentiated responsibilities at the hierarchy levels in planning, decision preparation, and decision making processes (Speier and Brown 1997).

However, other trends seemed to be recurrent in the studies and thus might be considered as generalized. High importance of management support tools for the implementation of laws and new regulations/directives on national and EU level was identified at the application area analysis and goes along with the results of the market potential analysis. On a national and an EU wide level, conflicts between nature protection and forest management planning are identified as the most important area, where management support tools could be supportive. Comparable trends are also reported from other economic branches (e.g., Henle and others 2008). On local and regional scale, a high importance of planning support with regard to conflicts between infrastructural development and forest

management was found in the application area analysis and the market potential analysis. This is supported also by results of other studies (e.g., Manners 1981). The trends on conflicts on a local/regional level are more distinct compared to the national and EU level. However, this is not true for the application area preferences at different scale levels. Here, more or less different profiles for management support tools can be derived from the study results. On local to regional level support of interdisciplinary and participatory communication processes in planning and support of linking forest management planning into planning processes on landscape level are seen as important features. On national/EU level the most important trend was the request of an active support (i) of early recognition of possible legal restrictions and consequences of management decisions and (ii) of the development of policies and strategies. ICT tools seem to correspond rather with the management support needs on local/regional level, while scenario simulation and visualization tools seemed to be

**Fig. 4** **a** Preferences of the application of management support tools in different phases of the decision process; **b** preferred technological solutions



more appropriate for management support on national/EU level. A subsequent step to support this assumption would be to test respective tools on different scale levels. However, this would have exceeded by far the scope of the presented studies.

The Delphi study helped to identify some examples for preferable tools and solutions having different levels of complexity, but can be applied on the different scale levels. These tools were offered to the study participants for test to support them among others in specifying their willingness to pay in the market potential analysis. The results on desirable attributes of an optimal tool at the user requirements analysis and the market potential analysis add very well. However, the described preselection of examples might have had an influence on the participants and their opinion. The participants in both studies preferred computer-based tools, which support interaction and

communication in planning processes over paper-based tools. This goes along with the statement of the application area analysis that at present, mostly paper-based tools such as the “simple” forest management plan and not the “desired” interactive instruments are in use (see also Matthies and others 2007)—at least in the participating countries. In consequence, the free access to computer-based support instruments is a consistently repeated demand in both studies. The preference of cost-free solutions and low willingness to pay for support unify the participants of the user requirements and the market potential analysis. This is not so much a result of a lacking awareness of possible benefits of such tools. As shown in our studies, the participants specified very clearly their needs and ideas on desirable solutions. But very often, the offered solutions do not correspond to the need of simple handling and navigation (Uran and Janssen 2003). The low

willingness to pay for support should thus be seen rather as unwillingness to pay for products with a lack of user friendliness and relevance. Different “home-made” forest GIS (Geographical Information System) or MIS (Management Information System) solutions are developed or under development by the forest administrations and state forest enterprises. For example, the participants of the study reported that a combination of digital site maps, results from forest inventory and data from growth and yield tables or forest growth models is often used to predict timber resource development under different management scenarios. However, these very specific solutions do by far not meet the criteria for a decision or management support tool. They are often preferred because their actual cost of development and adaptation are not accounted as additional financial effort. The maximal amounts of money the participants are willing to invest of up to 1,000 € for software, 100 € for online services and 50 € for handbooks are realistic compared to marked prizes for software or books and reveal a latent existing openness for suitable products. A contradiction seems to exist between the finding of the user requirements analysis that online tools are by far preferred and the lower amount and willingness to pay for them compared to software tools. This should be seen in the light of financial planning at state run or state associated institutions and the subjective whish of the participants to sustain an achieved comfort over a longer period. Once software is installed, it can be used independently from budgeting, while the financial means to sustain an online-service must be included actively in the yearly budget. This depends strongly on financial return by harvesting or provided services and on administrative rules and political decisions.

The missing differences in the user requirements between the two clusters “countries with traditional forest administration” and “countries with separation of forest administration and management” might be owed to the fact that reforms of the more traditional solution a forest administration are also discussed. Vuletic and others (submitted) neither found a strong impact of differing socio-economic frame conditions on the valuation of forest functions and services, nor big differences in the legislative frame, which specifies tasks for forest management and nature protection issues in forestry.

It seems that a more or less common understanding of forest management tasks, possible future challenges and resulting user needs in management support is developed in the countries participating in the presented case studies.

Maxim and van der Sluijs (2007) identified six criteria for quality test and confirmation of a case study for checking the quality of the knowledge produced, which could also be applied on the results of the presented studies.

- i. Reliability of information: => in all cases, information was based on the existing and available scientific knowledge.
- ii. Robustness of information: => criticism by the participants were taken into account.
- iii. Use of information produced by other stakeholders: => here, a shortcoming of the study can be identified as only selected stakeholders were integrated.
- iv. Relevancy of arguments for targeted subjects: => the relevance was ensured by prevailing and parallel analysis of ongoing research and by the implicit consideration of stakeholder's points of view in the different studies.
- v. Logical coherence of the discourse: => the different studies and analysis were conceived in a complementary way and the results were not contradictory.
- vi. Legitimacy of the information source: => in all three studies, participants shared a special interest in forestry and forest management planning. All of the participants are faced with the multiple aspects and challenges of forest management planning on sectoral and trans-sectoral level.

## Conclusions

A future need for computer-aided management support tools in forest management planning was identified in the presented studies. This is a result of an increasing number of actors in planning processes and an increasing complexity of information and considerations, which must be integrated in forest management decisions. The participants emphasized their need to be better supported especially in the implementation of laws, regulations, and directives in management planning. In addition, they identified the interest conflicts between (i) forest land-use and nature protection on national and EU level and (ii) forestry and infrastructural planning on local and regional level as a major reason for the need of improved management support solutions. Although, the participants pointed out a low willingness to pay for respective tools and services. Until now, increasing complexity and uncertainty in planning is a future threat in forestry. Existing management planning instruments are still considered as sufficient to address the current and future challenges. So far, no public pressure exists to prove the specific advantages of a management decision in the light of other alternatives. “Home-made” support solutions might give a feeling to be well prepared despite they support only partly increasingly complex processes in decision making.

Comparable marketing potential analysis for environmental management support tools can be found only rarely (e.g. Asgary and others 2007) and are not existent for

forestry. Therefore, it was not possible to compare or validate the identified trends. However, as a well-known economic rule the willingness to pay for future benefit is at all times very low. If a willingness to pay exists, it is mostly rather hypothetical (see e.g. Blumenschein and others 2001, Price 2007).

The discrepancy between the willingness to pay for management support tools and the identified future needs in using such tools suggest a need of alternative solutions for the mutual benefit of research and practice. A reasonable model could be the combination of freely available products and services with sponsoring or advertisement activities. A cost-differentiated access could be discussed, which guarantees a free access to basic solutions and a staggered fee for solutions with widened usage and application areas as yet realized in numerous web-based services. Finally, a future challenge for research is to develop generic solutions, which diminish the costs for their adaptation to different application areas and thus make development more efficient and accessible to a broader group of users. Here, the argument of a generic system standard with standardized interfaces to existing data pools and the hereby possible exchange with other users would also be a major factor to overcome the natural skepticism of users from practice against scientific solutions.

**Acknowledgments** The authors wish to thank all end-users and stakeholders, who participated in the regional studies. Without their great commitment it would not have been possible to realize these studies. The authors wish to thank also the funding organizations. The central study REFORMAN (MOE 07/S05) was supported by each partner nation in the SEE-ERA NET, REG-TRANSEKT (MOE 07/001) and ENFORCHANGE (0330634 K) by the Federal Ministry of Education and Research and IT-REG-EU (EUSN-06-J3-1-D1287-ERN) in the INTERREG-III-a program.

## References

Andersson F, Feger KH, Hüttl R et al (2000) Forest ecosystem research—priorities for Europe. *Forest Ecology and Management* 132(1):111–119

Asgary A, Levy JK, Mehregan N (2007) Estimating willingness to pay for hypothetical earthquake early warning systems. *Environmental Hazards* 7(4):312–320

Baskent EZ, Başkaya S, Terzioglu S (2008) Developing and implementing participatory and ecosystem based multiple use forest management planning approach (ETÇAP): Yalnızçam case study. *Forest Ecology and Management* 256(4):798–807

Blumenschein K, Johannesson M, Yokoyama KK, Freeman PR (2001) Hypothetical versus real willingness to pay in the health care sector: results from a field experiment. *Journal of Health Economics* 20 (3):441–457

Borg WR, Gall MD (1989) Educational research: an introduction, 5th edn. Longman, White Plains, NY, 534 pp

Buttoud G (2002) Multipurpose management of mountain forests: which approaches? *Forest Policy and Economics* 4(2):83–87

Buzan T (1995) The mind map book. BBC Books, London, UK, 319 pp

Castella JC, Boissau S, Thanh NH, Novosad P (2006) Impact of forestland allocation on land-use in a mountainous province of Vietnam. *Land-use Policy* 23(2):47–160

Cooke RM (1991) Experts in uncertainty: opinion and subjective probability in science. Oxford University Press, New York, Oxford, 330 pp

Dalkey N, Helmer O (1963) An experimental application of the Delphi method to the use of experts. *Management Science* 9(3): 458–467

EVALSED (2003) Delphi method. Evaluating Socio Economic, Development, SOURCEBOOK 2: Methods & Techniques, DG Regional Policy. [http://www.evalsed.info/frame\\_downloads.asp](http://www.evalsed.info/frame_downloads.asp). Accessed 16 January 2009

Farell EP, Führer E, Ryana D et al (2000) European forest ecosystems: building the future on the legacy of the past. *Forest Ecology and Management* 132(1):5–20

Führer E (2000) Forest functions, ecosystem stability and management. *Forest Ecology and Management* 132(1):29–38

Fürst C, Vacík H, Lorz C et al (2007) Meeting the challenges of process-oriented forest management. *Forest Ecology and Management* 248(1–2):1–5

Fürst C, Davidsson C, Pietzsch K et al (2008) “Pimp your landscape”—interactive land-use planning support tool. *Transactions on the Built Environment* (ISSN 1743–3509). *Geoenvironment and Landscape Evolution III* 2:219–232

Henle K, Alard D, Clitherow J et al (2008) Identifying and managing the conflicts between agriculture and biodiversity conservation in Europe—A review agriculture. *Ecosystems and Environment* 124(1):60–71

Johann E (2007) Traditional forest management under the influence of science and industry: the story of the alpine cultural landscapes. *Forest Ecology and Management* 249(1):54–62

Kissling-Näf I, Bisang K (2001) Rethinking recent changes of forest regimes in Europe through property-rights theory and policy analysis. *Forest Policy and Economics* 3(3–4):99–111

Ljungman L (1994) The changing role of forestry institutions in former centrally planned economies of Eastern Europe, *Unasylva* 178/45(3). <http://www.fao.org/docrep/t3350e/t3350e00.htm#Contents>. Accessed 2 July 2009

Manners G (1981) Regional policies and the national interest. *Geoforum* 12(4):281–299

Martinez de Anguita P, Alonso E, Martin MA (2008) Environmental economic, political and ethical integration in a common decision-making framework. *Journal of Environmental Management* 88(1):154–164

Matthies M, Giupponi C, Ostendorf B (2007) Environmental decision support systems: current issues, methods and tools. *Environmental Modelling and Software* 22(2):123–127

Maxim L, van der Sluijs JP (2007) Uncertainty: cause or effect of stakeholders’ debates? *Science of the Total Environment* 376(1): 1–17

Miller MM (1993) Enhancing regional analysis with the Delphi method. *Review of Regional Studies* 23(2):191–212

Montiel C, Galiana L (2005) Forest policy and land planning policy in Spain: a regional approach. *Forest Policy and Economics* 7(2): 131–142

O’Didia D (1997) Democracy, political instability and tropical deforestation. *Global Environmental Change* 7(1):63–76

Parviainen J, Frank G (2003) Protected forests in Europe approaches—harmonising the definitions for international comparison and forest policy making. *Journal of Environmental Management* 67(1):27–36

Pettenella D (1994) Institutional changes in forestry administrative structures: the Italian experience, *Unasylva* 178/45(3). <http://www.fao.org/docrep/t3350e/t3350e00.htm#Contents>. Accessed 2 July 2009

Price C (2007) Sustainable forest management, pecuniary externalities and invisible stakeholders. *Forest Policy and Economics* 9 (7):751–762

Rauscher MH, Reynolds KM, Vacik H (eds) (2005) Decision support systems for forest management. Special Issue of *Computers and Electronics in Agriculture* 49:1–3

Schmidt-Thomé P (ed) (2005) The spatial effects and management of natural and technological hazards in Europe, Final Report of the European Spatial Planning and Observation Network (ESPON) project 1.3.1, Geological Survey of Finland, Espoo, 197 pp

Scholles F (2001) Delphi. In: Fürst D, Scholles F (eds) *Handbook of theories and methods of spatial and environmental planning* 4. Dortmund Vertrieb für Bau- und Planungsliteratur, pp 203–206

Shimamoto M, Ubukata F, Seki Y (2004) Forest sustainability and the free trade of forest products: cases from Southeast Asia. *Ecological Economics* 50(1–2):23–34

Speier C, Brown CV (1997) Differences in end-user computing support and control across user departments. *Information & Management* 32(2):85–99

Spieker H (2002) Silvicultural management in maintaining biodiversity and resistance of forests in Europe—temperate zone. *Journal of Environmental Management* 67(1):55–65

Stupak I, Asikainen A, Jonsel M et al (2007) Sustainable utilisation of forest biomass for energy. Possibilities and problems: Policy, legislation, certification, and recommendations and guidelines in the Nordic, Baltic, and other European countries. *Biomass and Bioenergy* 31(10):666–684

Turoff M, Linstone H (1975) The Delphi method: techniques and applications. Addison-Wesley, Reading, MA, 620 pp

Uran O, Janssen R (2003) Why are spatial decision support systems not used? Some experiences from the Netherlands. *Computers, Environment and Urban Systems* 27:511–526

Van Paassen A, Roetter RP, Van Keulen H, Hoanh CT (2007) Can computer models stimulate learning about sustainable land-use? Experience with LUPAS in the humid (sub-)tropics of Asia. *Agricultural Systems* 94(3):874–887

Vos W, Meekes H (1999) Trends in European cultural landscape development: perspectives for a sustainable future. *Landscape and Urban Planning* 46(1):3–14

Weiss G (2004) The political practice of mountain forest restoration—comparing restoration concepts in four European countries. *Forest Ecology and Management* 195(1–2):1–13

White W, Lamb DR, Yun S (2004) Development of an empirically based area-type model. *Transportation Research Record* 1895: 25–30

Wohlgemuth T, Bürgi M, Scheidegger C, Schütz M (2002) Dominance reduction of species through disturbance—a proposed management principle for central European forests. *Forest Ecology and Management* 166(1–3):1–15

Wolfslehner B, Vacik H (2008) Evaluating sustainable forest management strategies with the Analytic Network Process in a Pressure-State-Response framework. *Journal of Environmental Management* 88:1–10

Vuletic D, Potocic N, Krajter S, Seletkovic I, Fürst C, Makeschin F, Galic Z, Lorz C, Matijasic D, Zupanic M, Simoncic P, Vacik H (submitted) How socio-economic frame conditions influence forest policy development in Central and South-Eastern Europe. *Environmental Management*